NASA TECH BRIEF

Marshall Space Flight Center

Fast Response Densitometer for Measuring Liquid Density

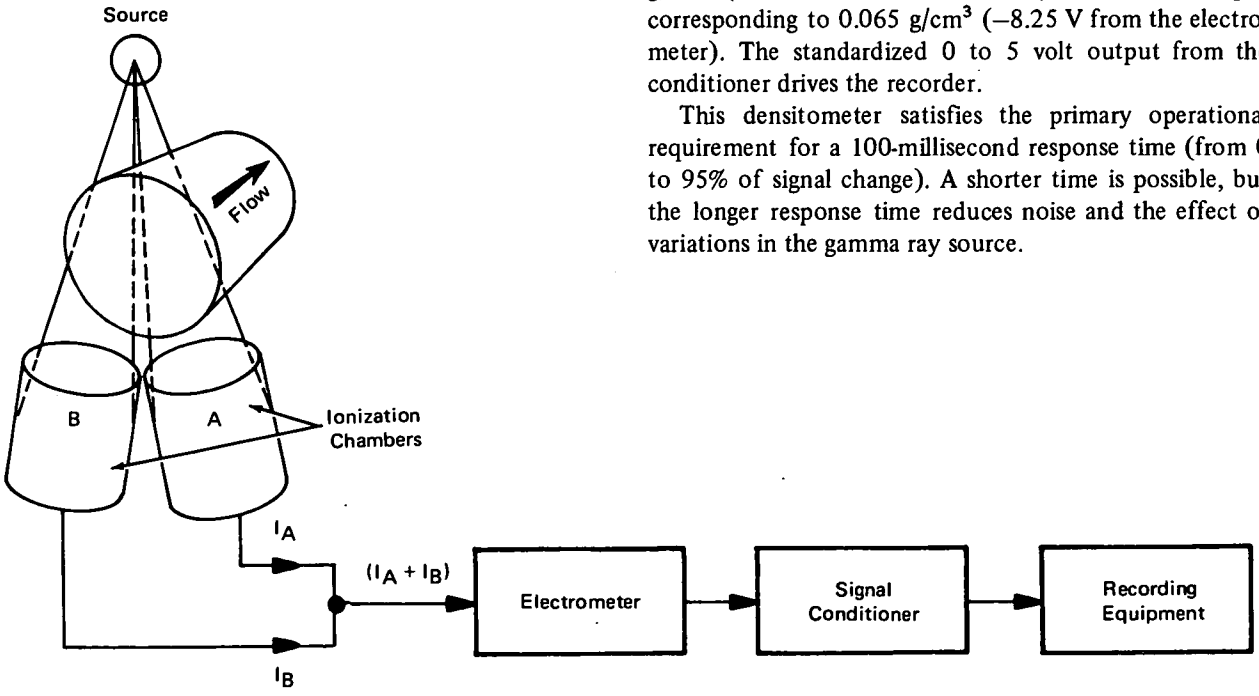
The problem:

Currently, time consuming methods (microwave and proximity sensing) are used to measure density in flowing liquids.

The solution:

A densitometer has been developed which produces a linear voltage proportional to changes in the density of flowing liquid hydrogen (LH_2). This unit has a fast response time and has been tested for system stability, statistical variation, and thermal equilibrium. The system accuracy is 2% of the total density span.

This basic design may be altered to include the measurement of other flowing materials.



How it's done:

As the liquid (LH_2 in this case) flows through the pipe, it is bombarded by gamma rays which are emitted by a source (Cs-137) placed a few inches away from the pipe (see figure). The scattering and absorption of gamma rays in the fluid depends upon the density of the fluid. Any change in the density of the fluid results in a change in the intensity of the rays reaching the detector (an ionization chamber) that is located on the other side of the pipe.

In the two detector system, the output from both ionization chambers (a current of about 0.25 μA from each) is the input to an electrometer. This electrometer amplifies the signal to -10 V full scale to interface with a signal conditioner. The signal conditioner generates a 5 volt output corresponding to a fluid density of 0.071 g/cm^3 (-8 V from the electrometer) and a 0 volt output corresponding to 0.065 g/cm^3 (-8.25 V from the electrometer). The standardized 0 to 5 volt output from the conditioner drives the recorder.

This densitometer satisfies the primary operational requirement for a 100-millisecond response time (from 0 to 95% of signal change). A shorter time is possible, but the longer response time reduces noise and the effect of variations in the gamma ray source.

(continued overleaf)

Note:

Requests for further information may be directed to:
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Reference: B72-10664

Patent status:

NASA has decided not to apply for a patent.

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